

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P16870PC	FOR FURTHER ACTION See Form PCT/YPEA/416	
International application No. PCT/SE2005/000194	International filing date (day/month/year) 14-02-2005	Priority date (day/month/year) 13-02-2004
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant Sectra Mamea AB et al.		

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 6 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
 - ☒ (sent to the applicant and to the International Bureau) a total of 5 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
- This report contains indications relating to the following items:

<input checked="" type="checkbox"/> Box No. I	Basis of the report
<input type="checkbox"/> Box No. II	Priority
<input type="checkbox"/> Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/> Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/> Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/> Box No. VI	Certain documents cited
<input type="checkbox"/> Box No. VII	Certain defects in the international application
<input checked="" type="checkbox"/> Box No. VIII	Certain observations on the international application

Date of submission of the demand 13-12-2005	Date of completion of this report 11-05-2006
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Form PCT/YPEA/409 (cover sheet) (April 2005)	

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Cover sheet

International patent classification (IPC)

A61B 6/00 (2006.01)

H05G 1/38 (2006.01)

Box No. 1 Basis of the report

1. With regard to the language, this report is based on:

- ☒ the international application in the language in which it was filed
☐ a translation of the international application into _____,
which is the language of a translation furnished for the purposes of:
☐ international search (Rules 12.3(a) and 23.1(b))
☐ publication of the international application (Rule 12.4(a))
☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on
- (replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*
- :

- ☐ the international application as originally filed/furnished
☒ the description:
pages 1-13 _____ as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____
☒ the claims:
pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 1-5 _____ received by this Authority on 18-04-2006
pages* _____ received by this Authority on _____
☒ the drawings:
pages 1-6 _____ as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____
☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

- 3.
- ☐
- The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing (specify): _____
☐ any table(s) related to the sequence listing (specify): _____

- 4.
- ☐
- This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing (specify): _____
☐ any table(s) related to the sequence listing (specify): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	<u>1-27</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-27</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-27</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)**Cited documents:**

- D1. US 4032784 A (RICH, L G), 28 June 1977
D2. WO 03075764 A1 (XCOUNTER AB), 18 Sept 2003
D3. US 4942596 A (EBERHARD, J W ET AL), 17 July 1990
D4. US 4972458 A (PLEWES, D B), 20 November 1990

In a view of new claims amended at 18-04-2006, documents D1 and D2 are reconsidered to represent the state of the art, together with documents D3 and D4.

The invention concerns a device for controlling exposure in an x-ray apparatus and solves the problem of optimising the exposure in every area of the image. The object of the invention is to solve this problem by combining pre-exposure with the diagnostic exposure in a real-time system, where the exposure needs only to be averaged in one dimension, while it may be fully optimised in the other dimension. The exposure time is controlled by varying the speed.

Document D1 describes a system for examining a body through the use of X-rays or other penetrating radiation which includes a means of moving a beam of radiation over a body to be examined and a selector for detecting the intensity of the non-absorbed or body-exiting portion of the beam. The system is formed into a dynamic closed loop by comparing the detected beam intensity with a given reference signal and utilizing the error signal so obtained to dynamically vary the body-incident intensity.

.../...

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

Document D2 describes a system for recording a 2D image of an object. D2 shows that the speed, at which the array of one-dimensional detector units is moved relative the breast during scanning, may be adjusted before or during an initial part of the scan, or on the optimum exposure time calculated.

However, none of the cited documents discloses a method and an arrangement using the sensors arranged on the edge of the detector, being in movement direction of the detector, whereby the signals received from the these sensors will decide the scanning speed.

In view of the cited documents such an arrangement and a method cannot be considered obvious to a person skilled in the art.

Therefore the invention claimed in claims 1 - 27 is novel and considered to involve an inventive step.

The invention is considered to be industrially applicable.

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

international application No.

PCT/SE2005/000194

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 26 lacks the essential features of the invention and should be omitted or revised.

P16870PC.C03

Claims

1. A method of controlling exposure time in an x-ray apparatus, for imaging an object,
5 the apparatus comprising an x-ray source and a displaceable detector being
arranged to move with a controllable speed across an image exposure area, said
detector having a first and a second edge, said first edge being in a movement
direction of said detector, the method comprising the steps of:
 - 10 a. setting a target signal (400), calculated to obtain a pre-defined signal to noise
ratio (SNR),
 - b. setting a detector Region Of Interest (ROI) (401), comprising a sensor (151)
on said first edge,
 - c. setting a start velocity (402),
 - d. start scanning (403),
 - 15 e. collecting a signal from said ROI (404),
 - f. compensating the signal with respect to at least one of ROI size and
efficiency (405),
 - g. comparing the signal with a target signal (S_{target}) and calculating a new
optimal velocity (406), and
 - 20 h. setting a new velocity during said scanning.
2. The method of claim 1, wherein the target value is calculated from object thickness
and spectrum incident on the object.
- 25 3. The method of claim 1, wherein the signal is acquired from a discrete number of
regions on said detector.
4. The method of claim 1, wherein the detector is a photon-counting detector and the
signal is the counted number of photons.
- 30 5. The method of claim 1, wherein a distance the detector moves between readouts
defines pixels in the scan direction, first dimension, and in a second dimension, the
detector comprises actual pixels.

6. The method of claim 1, wherein the detector functions as an exposure control as well as an image receptor.
7. The method of claim 1, wherein based on the number of photons collected in a predefined region of the detector the scan velocity is modified.
8. The method of claim 7, changing scan-speed with respect to a count rate change in said region for controlling the number of counts reached per a first dimension pixel.
9. The method of claim 7, comprising a feedback from the displaceable detector based on the count rate in said region.
10. The method of claim 9, wherein said feedback is substantially real-time and controls the scan speed of the detector.
11. The method of claim 10, wherein the exposure of each point along an x-axis is controlled based on the count rate of the said region and thus the entire image has a controllable signal level along the first dimension at least in said region in the second dimension.
12. The method of claim 9, further comprising minimizing total scan time by areas not covered by dense objects being scanned faster and thus exposed shorter.
13. The method of claim 1, wherein said detector itself is used to control the exposure.
14. The method of claim 15, wherein said step e comprises reading a number of counted photons or SNR.
15. The method of claim 15, wherein said x-ray apparatus is a photon counting device and the new velocity (V_{new}) is calculated as $V_{\text{new}} = V_{\text{old}} \times S_{\text{target}} / S_{\text{measured}}$.
16. The method of claim 1, wherein in said step g, if target signal is higher than measured signal (406') then velocity is decreased (4061') otherwise old velocity is kept (4062').

17. The method of claim 1, wherein said step g includes requiring new velocity to be at least higher than a pre-set minimum velocity.
- 5 18. The method of claim 1, wherein depending detector size the velocity decreases (4061"), if the target signal is higher than the measured signal (406") otherwise the velocity is increased (4062").
19. The method of claim 1, comprising the alternative step g of:
 - 10 o collecting a compression height ($h_{\text{compression}}$) data, projection and data about an examination type (4062"),
 - o collecting from previous examinations (4063"), based on previous step, typical examination object density profile ,
 - o calculating (4064") an optimal velocity profile based on estimation of said
 - 15 density profile and measured signals, and
 - o calculating new velocity based on the above data
20. The method of claim 1, wherein said step of choosing the ROI includes:
 - deciding an scan direction,
 - 20 - choosing ROI that will enter the object first, and
 - checking that ROI has sufficient number of detector elements working else choosing next appropriate ROI.
21. An arrangement for controlling exposure time in an x-ray apparatus (100), which
 - 25 comprises an x-ray source (110) and a displaceable detector (150), being arranged to be displaced with a controllable speed across an image exposure area, characterised in
 - that said detector comprises a first edge arranged as leading edge in a displacement direction, the arrangement further comprising means for setting a target signal (400),
 - 30 calculated to obtain a pre-defined signal to noise ratio (SNR), said detector having a Region Of Interest (ROI) (401) comprising a sensor in said first edge, means for obtaining a start velocity (402), means for collecting a signal from said ROI (404), means for compensating the signal with respect to at least one of ROI size and efficiency (405), compression means for comparing the signal with a target signal

(S_{target}), means for calculating a new optimal velocity (406), and means for setting a new velocity during said scanning.

22. The arrangement of claim 21, wherein said means for receiving detected signals is a processing unit and said means (804) for controlling the detector replacement is a motor controller.
23. The arrangement of claim 21, wherein said displacement controller controls rotation of said detector having a rotation centre in said x-ray source.
24. An X-ray apparatus (100) of a photon counting type, comprising an x-ray source (101) and a displaceable detector (105) being arranged to move with a controllable speed across an image exposure area, characterised by an arrangement for counting the number of photons detected by the detector, said detector comprising an end arranged as leading edge in the displacement direction, means (802) for comparing the counted number of photons from a sensor in said end under a scanning movement with a pre-set value, and means (803) for controlling the speed of the detector displacement with respect to a result obtained from a signal from said sensor corresponding to a density of an object to be examined under said scanning movement.
25. A computer useable medium having a computer readable program code embodied therein to enable controlling exposure in an x-ray apparatus, when imaging an object, the apparatus comprising an x-ray source, a displaceable detector, the computer program code being arranged to control displacement of said detector array with a controllable speed across an image exposure area, the computer program code comprising: an instruction set for acquiring a signal relating to photons incident on an edge portion of the detector in the scanning direction under a scanning movement, an instruction set for comparing said acquired signal with a target value, and instruction set for controlling the speed of detector displacement with respect to the result of the comparison under said scanning movement.
26. A computer useable medium having computer readable program code embodied therein to enable controlling exposure in an x-ray apparatus, for imaging an object,

- the apparatus comprising an x-ray source and a displaceable detector being arranged to move with a controllable speed across an image exposure area, said code comprising: a first instruction set for acquiring a signal relating to photons incident on at least a part of the detector under a scanning movement, a second
- 5 instruction set for comparing said acquired signal with a target value, and a third instruction set for controlling the speed of detector displacement with respect to the result of the comparison under said scanning movement.
27. A computer program for controlling exposure in an x-ray apparatus, when imaging an
- 10 object, the apparatus comprising an x-ray source, a displaceable detector, the computer program being arranged to control displacement of said detector array with a controllable speed across an image exposure area, the computer program comprising: an instruction set for acquiring a signal relating to photons incident on an
- 15 edge portion of the detector in the scanning direction under said scanning movement, an instruction set for comparing said acquired signal with a target value, and instruction set for controlling the speed of detector displacement with respect to the result of the comparison under said scanning movement.